Conductive education for children with cerebral palsy

The HTA Unit of the AHFMR was approached by Children's Services, Alberta Learning, and Alberta Health and Wellness to conduct a systematic appraisal of the published research and to determine the evidence to date. Using the tools of systematic review the HTA Unit critically appraised the research from 1990 onwards on conductive education (CE) as a learning approach or therapeutic intervention. The review focused on the safety and effectiveness of CE for children with motor disabilities.

Describing CE is complex due to the diversity of programs across time and countries. András Petõ founded CE shortly after World War II through his personal practice in Hungary. Since the mid 1980's, interest in CE has grown and it has been adopted and adapted in other countries. There are now more than thirty centers or institutions for CE in the UK, more than forty in Germany, more than fifty in the United States and others in Israel, Scandinavia, Australia and Canada.

CE is an educational method for individuals with motor disorders who are at risk of learning difficulties over the course of their development. CE teaches children with cerebral palsy (CP) to carry out coordinated and integrated actions through comprehensive education and daily routines. The goals of CE are to help the child to learn how to find ways to achieve personally formulated goals, to experience greater independence and exercise choice.

Because of the major limitations of all studies to date, evidence on the efficacy and effectiveness of CE is sparse and of poor quality. The efficacy of CE is not established, nor is the nature of CE well defined, as it is a fast-developing educational approach. The available scientific literature does not show this approach to be superior to, or more effective than other treatment methods. The research evidence, while not establishing that CE is more effective than other forms of therapy for children with CP, does seem to indicate that children in the CE groups kept pace with their peers receiving other therapies. Other than the issue of decreased hip mobility identified in one study, no harm was identified from CE in the other studies.

The report concludes that CE is a rapidly developing sector and can be manifested in different ways in different social contexts. CE is practiced differently in different countries. CE programs have been modified with components added from other approaches and special education. Most adaptations of CE have not involved residential treatment (as originally practiced in Hungary); some use conductors only, while others use multi-disciplinary teams. Outcomes and conclusions from research conducted in other countries, or from other programs may not be transferable to other settings.

It is important in any research studies on CE, to conduct the research in the setting CE has been adapted to. The authors suggest that any local adaptations of CE, which is the case for the use of any other treatment programs for children with CP, should be supported by empirical data from good quality studies of its efficacy and effectiveness. There is a need for rigorous studies and program evaluations of CE in the Alberta setting.

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Conductive education for children with cerebral palsy

Sue Ludwig, Patricia Leggett,
Christa Harstall

November 2000

HTA 22

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This Health Technology Assessment Report has been prepared on the basis of available information of which the Foundation is aware from public literature and expert opinion and attempts to be current to the date of publication. It has been externally reviewed. Additional information and comments relative to the report are welcome and should be sent to:

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ISBN 1-896956-33-5

Alberta's Health Technology Assessment program has been established under the Health Research Collaboration Agreement between the Alberta Heritage Foundation for Medical Research and the Alberta Health Ministry.

101-04317/

ACKNOWLEDGEMENTS

The Alberta Heritage Foundation for Medical Research is most grateful to the following persons for provision of information and comments on the draft report. The views expressed in the final report are those of the Foundation.

Mr. Paul Childs, Alberta Health & Wellness, Edmonton

Dr. Gerry Kiefer, Alberta Children's Hospital, Calgary, Alberta

Ms. Brenda Waye-Perry, Alberta Health & Wellness, Edmonton

Dr. Dinah Reddihough, Royal Children's Hospital, Australia

Mr. Andrew Sutton, National Institute of Conductive Education, England

Dr. Virginia Wright, Bloorview MacMillan Centre, Toronto, Ontario

SUMMARY

- Conductive education (CE) is an educational method that recognizes that children with chronic motor disorders such as cerebral palsy have problems controlling and coordinating movement. The psychological and social effects that stem from these are amenable to teaching/learning. It originated in Hungary and was developed by András Petõ.
- The goals of CE are to help children with cerebral palsy to learn how to find ways to achieve personally formulated goals, to experience greater independence and exercise choice.
- Interest in CE has extended beyond the Petõ Institute in Hungary and CE programs, manifested in a variety of ways, now exist in many countries, including Canada. Other types of intervention programs have also been used for children with cerebral palsy. The most common of these is neurodevelopmental therapy (NDT) in Canada.
- The effectiveness of CE in Hungary has been anecdotally documented. No research studies have been located that documented that children undertaking programs based on the principle of CE made superior progress to children undertaking traditional programs. Nevertheless other countries have adapted and adopted some of the aspects of CE as it originated in Hungary. Studies evaluating the efficacy of the programs in these countries have evaluated adapted CE models; not the original model as developed by Petõ.
- A systematic review of the literature indicates that the effectiveness of CE is not established. There is no good scientific evidence to support the use of CE in place of other treatment programs for children with cerebral palsy. The research available is methodologically inadequate. However, other than one study that showed that the CE group experienced decreased hip mobility, no harm from CE programs was noted in any of the other studies. Children in the CE groups kept pace with their peers who received other types of therapy.
- CE is a rapidly developing sector and can be manifested in different ways in different social contexts. CE programs have been modified with components from other approaches and special education.
- Any local adaptations of CE, which is the case for the use of any other treatment programs for children with cerebral palsy, should be supported by empirical data from good quality studies on its efficacy and effectiveness.

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INTRODUCTION

Three Alberta provincial government ministries - Alberta Children's Services, Alberta Learning and Alberta Health & Wellness - jointly requested the Health Technology Assessment (HTA) Unit of the Alberta Heritage Foundation for Medical Research to assess the evidence of effectiveness of conductive education as a treatment program focusing on children with cerebral palsy. A review was requested to help the ministries answer the question: "Is conductive education as a learning approach or therapeutic intervention safe and efficacious for children with disabilities such as cerebral palsy that impact neuromotor functioning?" The requestors of the review also asked that the question, "what is the profile of the child who would benefit from this intervention?" be addressed. This assessment profiled the characteristics of children whenever possible if the research studies provided such information. It did not answer clinical questions such as the appropriateness of treatment programs for children with motor disorders.

In response to the request, the HTA Unit conducted a systematic search for, and critical appraisal of published scientific evidence regarding the impact of conductive education on the overall learning and health status of children with cerebral palsy. Conductive education is an intervention that is most commonly utilized for children with cerebral palsy [34], but it is also used in the treatment of children with spina bifida and other motor disorders. It is also used for adults with motor disorders. Details of the methodology used in the search strategy and critical appraisal of the studies are shown in Appendix A.

BACKGROUND

Describing conductive education is complex due to the diversity of programs across time and countries. Conductive education was founded by András Petõ through his personal practice in Hungary shortly after the end of the Second World War [21]. Petõ considered disability as an educational challenge and not as a biological problem.

Conductive education is an educational method for individuals with motor disorders who are at risk of learning difficulties. Despite damage, the nervous system still possesses the capacity to form new functional connections. To mobilize this capacity, active learning is required. CE predicates on the notion, if taught appropriately, children and adults can learn (personal communication, A. Sutton).

"More fundamentally, conductive pedagogy leads (hence conducts) learners to find satisfaction from trying, to recognize that they can set themselves goals and intend to achieve them, and to find their own way towards achieving these ends. It is this psychological change that is the prime objective of conductive pedagogy" (personal communication, A. Sutton).

Conductive education does not require special machines, instruments or aids with advanced technology. In CE the environment is not changed, rather the motor disabled person needs to master the environment, including their own bodily environment. CE teaches individuals to carry out coordinated and integrated actions through comprehensive education and the pedagogic creation of appropriate, positive motivations and orientations towards learning. The goal of CE is "learning how to learn, learning to find personal ways to achieve personally formulated goals, experiencing greater independence and exercising choice" [21].

CEREBRAL PALSY

One of the most prevalent motor disorders in childhood is cerebral palsy (CP). The cause of CP is not damage to muscles or nerves; rather faulty development or damage to motor areas in the brain that disrupts the brain's ability to adequately control movement and posture [32]. The most common type of therapy for CP in Canada is neurodevelopmental therapy (NDT) [28]. See Appendix B for a brief discussion of CP and intervention strategies.

The prevalence of CP in the western world has been estimated at about 2 to 2.5 per thousand school-age children [31]. In the province of Alberta between the years of 1985 and 1988, 248 children were diagnosed with CP, giving a prevalence rate of 2.57 per 1,000 [36].

CP is not one condition with a single cause. It is a group of disorders which, although related, have different causes. It can be acquired after birth (about 10 to 20 percent) from brain damage that follows brain infections such as bacterial meningitis, viral encephalitis or head injuries. It can also be congenital (present at birth). The causes of congenital CP are often not known, however low birth weight, infections during pregnancy (such as German measles), Rh incompatibility, and severe oxygen shortage during labor and delivery have all been associated with CP.

In an Alberta study by Robertson et al. [35], CP was linked to low birth weight. Of 248 children with confirmed CP, 92.3% were identified to have congenital CP. Just over one-third of the 248 babies were born with a low birth weight. Cohort prevalence of CP for babies of extremely low birth weight (500-999 grams) was 98.4; for babies of very low birth weight (1,000-1499 grams) the prevalence rate was 78.5, and for babies with low birth weight (1500-2499 grams) this rate was 17.7. This compares to a prevalence rate of 0.9 per 1,000 for babies over 4,000 grams [36].

CONDUCTIVE EDUCATION

Empirical studies on the effectiveness of CE in Hungary were not done, or are not readily available. Evidence of the effectiveness is anecdotal, written by visitors to the Petõ Institute in Hungary. Bairstow et al. [4] noted that no clear or comprehensive account of the objectives, methods or principles of CE were published in English. One available English translation is by Hari and Akos [18]. Some of the basic principles of CE, derived by Bairstow et al., are identified in this translated text:

1. The concepts of orthofunction as a developmental problem and dysfunction as personality problems underly CE. "Ortho functioning is a psychological state, the readiness to recognize that one can learn and achieve things, that it is reasonable to formulate one's own intentions and seek ways of fulfilling these. Depending upon age and severity of the underlying condition, what is actually achieved will vary considerably from individual to individual. The important thing is an active orientation to life and learning. Dysfunction is the opposite of orthofunction, surrender to the disability, passivity, learning not to learn. The goal of CE is to turn dysfunctionals into orthofunctionals" (personal communication, A. Sutton).
2. There is a daily schedule within the program that covers the time period from waking to sleeping.
3. Within the time schedule there is a hierarchy of task series to be learned by each child during the day.
4. Ongoing evaluation and follow-up of the task series occurs to monitor the progress of each child.
5. Maintaining attention is important in CE and constant evaluation of attention and arousal are created through a variety of ways, like alterations in the daily schedule.
6. "Conductive facilitation" includes careful observation of each child to meet individual needs and differences. Conductors allow each child to carry out activities unassisted, but with guidance, support and access to equipment to generate the will to make things happen for themselves.
7. Interpersonal facilitation is also an important component of CE. CE assumes learning and development occurs with emotional commitment by both the learner and the conductor.
8. The group is the principle vehicle for interpersonal relationships in CE. CE need not necessarily be undertaken within a group, though group pedagogy is acknowledged as a very powerful

pedagogic tool (personal communication, A. Sutton). Each group was originally composed of 20 to 30 children, of both sexes. There is a definite and general tendency for smaller groups (20 children) in the three to eleven age range (personal communication, A. Sutton). Group membership is carefully chosen and is not homogeneous.

9. "Rhythmic intention" is used to help the children produce movements that are fluid and voluntary. This involves setting up a rhythm for an action to be practiced and then cueing the child to a beat. The child is also taught to say the words to describe the action while doing the movement [40]. A difficult task is rehearsed in the child's mind, or the child talks him or herself through the action. In CE, the conductor gives a verbal intention, the child repeats it, makes it his or her own, and then attempts to carry it out. Over time the conductor pulls out leaving the child to say it and carry it out. Finally, this becomes automatic.
10. CE is a unified system of conductors and conduction and its concepts form a unitary whole. The success of CE requires a conductor's presence and organizing of directive functioning. A conductor acquires the necessary theoretical and practical knowledge through a training course.

Bairstow et al. [4] noted that the translation does not explain the key features of the system, many statements and beliefs seem never to have been challenged or tested, and many assertions are not believable (eg. dysfunction is a personality problem and CE is aimed at improving the whole personality). They also noted that there are terms that are not well defined.

Just as the definition of CE is difficult to pin down, so are the criteria for acceptance into CE programs. Hur [22] noted that conductors chose children to participate in the CE study in Birmingham, but the choices made by "experienced" senior conductors were not reliable despite pre-set criteria for admission to CE. She wrote; "It is believed that these obvious errors were due to unsophisticated and non-standardized selection methods employed by the conductors. It seems that judgement depends on the conductors' personal subjective opinions or feelings, yet it is claimed that no one can judge the suitability of a child for CE, only conductors".

Holt [20] reported that disabled children are not accepted into CE programs in Hungary if they have a "mental handicap sufficient to impair responsiveness to conductor's requests, impairments of vision or hearing, poorly controlled fits, progressive disorders, biochemical disorders, and major orthopedic problems, including limb reduction".

Since the mid 1980's, interest in CE has grown and it has been adopted and adapted in other countries. There are now more than thirty centers or institutions for CE which employ conductors in the UK, more than forty in Germany, more than fifty in the United States and others in Israel, Scandinavia, Australia and Canada [45].

The adaptation of CE to fit within the educational and social structures of other countries has created even further difficulties in defining what CE is. Some models of CE developed in other countries have been based on "principles of CE" [4], while others have called their models "CE-based" [10, 13, 35]. CE in Alberta is currently being offered in Calgary. See Appendix C for a brief description of the Calgary programs.

To date, no health technology assessment reports on the effectiveness of CE for children with cerebral palsy have been conducted. One critical review conducted by French and Nommensen [15] in 1992 concluded that "inconsistency across studies in outcome measures, program characteristics, and methodological flaws, negate providing a definitive answer to the efficacy debate". Points made in the report include:

- The quality of the available evidence on the effectiveness of CE is limited.
- The heterogeneous nature of the samples in the studies reviewed is clearly evident.
- CE as practised outside of Hungary is fragmented; each program has adapted CE in a unique way.
- Studies of the effectiveness of CE are characterized by major methodological flaws in design and conduct, affecting outcomes.
- Outcomes measures in studies reviewed vary considerably, many are non-standardized.
- Further evaluations need to include experimental and control groups (matched on a number of characteristics and randomly assigned to groups), homogeneous diagnostic samples, and employ a broad spectrum of outcome measures.
- Minimum standards for CE programs need to be developed to assist future evaluation.

PRIMARY STUDIES ON CONDUCTIVE EDUCATION

Six studies were evaluated and are summarized Table 1. Four of these studies involved the comparison of a CE group to a control group receiving individual physiotherapy [10], NDT [35], special education programs [4], and traditional early intervention programs [13]. A more complete description of each study including the measures used can be found in Table 4 in Appendix D.

Table 1: Summary of CE studies

Study	Setting	Methods	Authors Conclusions
Bairstow et al. [4] 1993 non-randomized, prospective controlled study, 1989-1992	UK	N= 19 CE group N= 17 control group receiving special education programs	Children receiving CE made progress on a wide range of measures, but there was no evidence to support predictions that they would achieve better rates of progress than the control group.
Coleman et al. [13] 1995 non-randomized, prospective controlled study, 26 weeks	Australia	N=11 CE group N= 9 control group receiving early intervention services	The study failed to find evidence for significant progress in any of the six developmental areas assessed for either the CE or control group from the therapists' ratings, and no significant differences in stress levels for parents in either group.
Catanese et al. [10] 1995 Non-randomized, prospective controlled study, 26 weeks	Australia	N=17 CE group N=17 matched control group, receiving individual physiotherapy	The CE group improved in motor performance and parental coping variables. Both groups showed improvement on the cognitive measures, with the control group demonstrating slightly greater gains.
Reddihough et al. [35] 1998 Randomized, controlled, prospective study, 6 months	Australia	N=17 matched pairs, randomly assigned to CE or control group as well as N=13 matched pairs in non-randomly assigned group. The control groups received a "treatment approach based on meeting the child's therapeutic needs"	Children in CE-based programs made similar progress to those in control groups.
Bochner & Chapparo [8] 1999 Evaluation of 2 CE programs, non – randomized non-controlled, descriptive, over 12 months-2 years	Australia	N=6 school project N=7 preschool project	The amount of progress made by individual children varied widely; some showed almost no change, others improved in selected skills. There was almost no change in academic and communication skills and no evidence of attempts to generalize trained skills to untrained tasks or contexts. Results suggest that programs based on CE are no more effective than other currently-available forms of intervention for children with CP.

Table 1: Summary of CE studies (cont'd)

Study	Setting	Methods	Authors Conclusions
Sigafoos et al. [38] 1993 non-randomized, non-controlled, descriptive study, 6 weeks	Australia	N=10 children enrolled in a 6 week CE program organized by parents	The results of the study are limited because the evaluation period was brief, involved a small number of children and reported only a few outcome measures. The results indicate there was little improvement in mobility or eating skills for children in the older group. Parents perceived some improvement in their child in at least one identified goal area.

Bairstow, Cochrane & Hur [4]

This study is frequently referred to as one of the first and more extensive empirical investigations of CE. It was also reported in a separate article by Hur in 1997 [23].

Critical appraisal of the Bairstow study.

1. ***The study should provide a description of the sampling strategy.***

   Neither random selection nor assignment was used. The authors note that it was not possible because the groups were selected by conductors from Hungary. Matching occurred between the CE and control groups on a number of characteristics; however, matching did not achieve groups that were the same. In the CE group there were ten children who were severely handicapped as opposed to the control group that had only six. Spivack [39] stated that:

   > the attempt at matching groups of children from two places was more like mismatching. It is foolhardy to try to match cerebral palsied groups since each child is so very different, the site of lesion is different, the degree of weakness is different, and the personality and behavior of the child are hardest to match. The diagnostic and severity differences coupled with the small numbers in each group are very significant problems in this research.

   The researchers tried to help ensure that the groups were similar in the criteria for inclusion in CE. To minimize conductors' selection bias, they "concealed" the children to be chosen for the control group to children who were potential applicants for CE at the Petõ Institute in Hungary. These children were not differentiated from those applying for the regular CE programs, thus conductors did not know who the candidates for the control group were.

   The size of the sample was small (N=19 in the CE group, and N=17 in the control group). Cochrane addressed this criticism stating that the 20 children at the Birmingham Institute from which the sample was chosen was the entire

population in CE at the time. The Birmingham Institute was a system in training and transition. Therefore, "our results are entirely reliable for that population, but I stress that our results refer only to the children at the Birmingham Institute admitted in 1987 and 1988" [12].

A great deal of attention was paid to sample selection. The research team was not involved in the selection of the sample. The children in the CE group were put forward by agencies and parents in response to a notice of admission that outlined criteria for the group. The control group was chosen from special schools identified by the Department of Education and Science as offering "good" programs for children with CP. It was desirable to have a comparison group enrolled in well regarded programs. The criteria whereby the quality of the programs were judged was not provided.

Senior Hungarian conductors selected the children for each group from the pools of candidates. Hur [23], in her article, noted that although the sample selection was made based on criteria established for inclusion in CE programs at the Petõ Institute, that their judgement was not reliable. One child who withdrew from the CE group had severe and profound intellectual ability, limited expressive and receptive language and was blind. Three children in the control group who were chosen by conductors had similar problems and were excluded. Hur [23] wrote:

> It is believed that these obvious errors were due to unsophisticated and nonstandardised selection methods employed by the conductor. It seems that judgement depends on the conductors' personal subjective opinions or feelings, yet it is claimed that 'no one can judge the suitability of a child for CE, only conductors'.

2. ***The study should provide an adequate description of experimental and control groups.***

   The control and CE groups were described by age and various other variables. The description of the groups was thorough. All children had CP; the severity of it and level of intellectual ability were well described, as were previous treatments.

3. ***The study should provide an adequate description of the context of the study.***

   The study was conducted in the UK in Birmingham and the Greater Manchester area. In the Final Report the context of the study is well described. The authors provided a discussion of the background and context of CE in the UK, and differences between CE in the UK and in Hungary. In the report the authors note that one of the objectives of the evaluation was to determine the extent to which the form of CE developed in the UK was an accurate replica of that established at the Petõ Institute. The programs were

similar; however, not identical. The researchers made it clear that they were evaluating CE as it was implemented at the Birmingham Institute, not as practised in Hungary. Some problems with transplanting CE from Hungary into the UK have been discussed by others. Hari [17] wrote that the evaluation "was an evaluation of the work 'as provided at the Birmingham Institute' making it difficult to generalize results beyond the study."

The sponsor of the research was the Department of Education and Science. All costs were born by the Foundation for Conductive Education (personal communication, A. Sutton).

4. ***The study should provide an adequate description of the interventions/ program.***

The report described the interventions/programs for both the CE group and control group in detail. In the CE group all children were engaged in a single timetabled program, whereas children in the control group each followed a different timetable. There were "marked differences" between the groups in the amount of time spent on academic and physical programs. The CE group received much more physical programing (14 hours per week), as compared to the control group who received just over three hours per week. In the control group, much more emphasis was place on academic programing (8 hours per week) whereas the CE group received only 4 hours per week.

The CE program was run by teachers who were being trained as conductors. They were undergoing initial training by Hungarian conductors.

The extent and nature of parental involvement in the CE program or control group programs was not clear.

5. ***The study should provide a description of the statistical methods used.***

The authors note the study employed a two-by-three factorial design with repeated measures on one factor (group membership) using a two-way ANOVA.

6. ***The study should report outcome measures.***

A number of outcome measures were reported in the study. Seven main factors were identified from the 47 variables and included: "gross motor", "expressive language", "cognitive and social", "independence and motor", "physical and gross motor", "behavioral problems", and "independence and social factors". During the course of the study, the researchers investigated and found no major differences in factors that may have happened over time to give one group any advantages.

Measurement time periods were well described. The measures were standardized with good reliability and validity. Yule [47] stated, "this means that the finding that the children given conductive education did NOT make

better progress than the Manchester children receiving more conventional special education is well founded". Sutton, however, noted that the report made no reference to the problem researchers have in obtaining "meaningful" scores from testing children with motor disorders. He wrote: "without very clear assurance of why this very large raft of numerical scores might be regarded as valid for the population tested, one should be forgiven for wondering whether all that this study demonstrates, on children attending four schools across the country, is the general and well-known problem of finding instruments appropriate for documenting the skills and development of children with cerebral palsy" [41].

One child withdrew from the CE group and three from the control group. No mention of the effects of this on results was provided. Follow-up to the study was not a part of the study design.

Coleman, King & Reddihough [13]

The first of three research projects carried out by the same group of researchers in Australia was called the Tongala Project.

Critical appraisal of the Coleman et al. study.

1. ***The study should provide a description of the sampling strategy.***

   This study was a quasi-experimental design. The subjects in the study were chosen from programs in Melbourne. No randomization occurred, the children in the groups were already enrolled in CE or early intervention services. Initially 26 children were enrolled in the study, but six withdrew during the evaluation period.

   The authors provide no information about who was involved in the selection of the sample, or how the prospective participants were approached. No attempt was made to match the groups initially, therefore it cannot be assumed that groups were equivalent. These factors raise concerns about drawing effectiveness conclusions. There was no mention of exclusions or refusals.

2. ***The study should provide an adequate description of experimental and control groups.***

   A brief description of the children was given by the researchers. An age range for the entire sample was provided; the sex of the sample was described (10 males, 10 females). All of the children had CP. The severity of disorders was not stated. There was no mention of previous treatment programs, or any accompanying medical illnesses.

3. ***The study should provide an adequate description of the context of the study.***

   The authors provide a brief discussion of the Australian context and CE. They describe the location of the CE program as being based at Tongala and in metropolitan Melbourne. The CE groups received guidance from Hungarian conductors; however, they note, "it clearly was not CE as practised in Hungary but rather a modified system to cater to a different culture and approach to the management of young children with physical disabilities". Factors contributing to the modified system were not discussed.

   The description of settings was not adequate. The researchers only mentioned the number of programs around the area that participants were enrolled in. All programs were located in Tongala and metropolitan Melbourne.

   No mention of funding sources for CE was provided, although there was mention of funding for the evaluation study.

4. ***The study should provide an adequate description of the intervention/ program.***

   The CE groups were modeled on the "mother and baby" style program and received guidance from a Hungarian conductor. Program features for all groups were provided briefly. Other staff present were listed, but their roles were not described. There was no mention of other therapy.

   Treatment intensity was poorly delineated. The children in the CE group received their CE-based program with five mornings or five afternoons every two weeks. The children in the control group received early intervention programing, using "more traditional approaches to therapy and special education". What this constituted was not presented. Over the time period of two years no discussion of extraneous factors such as staff attrition was provided.

5. ***The study should provide a description of the statistical methods used.***

   The researchers provided statistical analyses of the assessment instruments; inter-rater reliabilities, analysis of validity of the assessments and then of the data.

6. ***The study should report outcome measures.***

   Measurement times were stated pre and post treatment at 26 weeks. The assessment tools were described at some length. The researchers established reliability and validity of the instruments.

   Standardized instruments including the Vulpe Assessment Battery (VAB) as well as the questionnaire on resources and coping (QRS-F) that was used to measure parental perception of coping with their disabled child. The

children were videotaped while being assessed. Each child was given a code; the tapes were analyzed by three independent assessors (two physiotherapists and one speech pathologist) who were unaware of group membership.

Each videotape was evaluated by two therapists to establish inter-rater reliability. Convergent validity was also established for the ratings by correlating parent ratings with assessor ratings.

During the study six participants withdrew, five from the CE group. Reasons for the withdrawal were provided; however, no discussion on the effect of the withdrawals on the results was given. No follow-up was discussed in this study.

Catanese, Coleman, King & Reddihough [10]

This was the second study in the same year in Australia.

Critical appraisal of the Catanese et al study.

1. ***The study should provide a description of the sampling strategy.***

   This study was a quasi-experimental design. The sample in this study was small (N=17 in each group).

   There was no random assignment to groups. An attempt was made to match the groups for age, type and severity of physical and cognitive impairment; however, some of the children who continued to attend the pre-school CE program were of school age. The parents requested they extend their CE program for one more year and delayed the start of school. This delay did not occur in the control group. These children were in school and thus they received a range of different education services and intensity levels.

   The CE group came from those already enrolled in the Yooralla program. It may be assumed that the treatment group was a convenience sample. The control group was chosen from a register of children with CP; however, the approach to select perspective participants was not provided. It was unclear whether the control group was also a convenience sample. Information was not given about the registry. The study did not state who did the sampling.

   The authors make no mention of those excluded or who refused to participate in the study.

2. ***The study should provide an adequate description of experimental and control groups.***

   The researchers described the age range and sex of children for the overall group, and noted that all had a diagnosis of CP and a significant proportion also had a mild or moderate intellectual disability. The groups were similar in terms of intellectual ability; however, whereas the control group contained

five children who were severely disabled, the CE group only had one in this category.

No mention was provided about history of previous treatments or of accompanying medical disorders. The treatment group was composed of children who "remained at Yooralla for an extra year", indicating that they had previous CE exposure.

3. ***The study should provide an adequate description of the context of the study.***

   A brief description of the context of Australian CE was provided. The CE programs in Victoria were described as being modified in that they are less intensive and non-residential. The parents of the CE group requested that their children spend an extra year at the centre, rather than starting school. It is reasonable to conclude that this commitment may have biased the parents' ratings.

   Funding for the research study was mentioned, but not for the programs themselves.

4. ***The study should provide an adequate description of the interventions/ program.***

   Little description was provided about the interventions received by either group. The authors did not provide any information on the number of hours of therapy the groups received, only that the CE group received therapy based on the principles of CE, and the control group received "an individual physiotherapy program".

   It is possible that the results might have been due to differences in hours of intervention received rather than the intervention itself. The authors note that the control group were "undertaking a variety of programs of different therapeutic intensity".

   Little description was provided of the staff involved with either group, or of the parents.

5. ***The study should provide a description of the statistical methods used.***

   The researchers used a variety of statistical methods to analyze their data. They note that due to the large number of dependent variables and subsequent analyses, the risk of making a Type I error was increased (incorrectly rejecting a true null hypothesis). The small sample size precluded their ability to set a stringent Type I error rate. Therefore, they noted that the results need to be viewed with caution and it is the overall trend, rather than single outcomes that need to be the focus of interpretation. Means and standard deviations were presented for each group on six measures. The F values and probability levels were reported for statistical tests conducted.

6. ***The study should report outcome measures.***

Two measurement times were stated. Reliability or validity information on the assessment tools used were not reported, although the measures were standardized and have a record of reliability and validity. The assessment tools were referred to in a past study using the same methods.

Raters were blinded to group membership, but inter-rater reliabilities were not reported for the ratings.

There were no discussions of the appropriateness of the use of some of the assessment instruments with this group of children. For example, the appropriateness of applying the standardized tests to assess cognitive ability of children with physical disabilities was not discussed, except to note that they were chosen on the basis of requiring minimal motor skills. The children in both groups were mildly to moderately cognitively impaired. Ceiling and floor effects might have affected results. Catanese and Cotter question the validity and reliability of standardized tests for this group of children [9].

The authors do not discuss drop-outs or follow-up in this study.

Reddihough, King, Coleman & Catanese [35]

This was the third study conducted by the same group in Australia. This study attempted to deal with many of the methodological issues that precluded definite conclusions in the previous two studies. Thirty-four children with CP were recruited whose parents were willing to have them randomly assigned to either a CE or a control group receiving traditional treatment. Another group of parents of thirty-two children were willing to participate, but were not willing to have their child randomly assigned to a group. They were included in the study, but their progress was analyzed separately.

Critical Appraisal of the Reddihough et al. study.

1. ***The study should provide a description of the sampling strategy.***

Part of the study was a randomized controlled trial; the other part was a non-randomized controlled study. Some parents were not willing to accept randomization. Their children were still studied, but as a separate group. The authors note that they observed that the children in the non-randomly assigned or self-selected programs were more content and that this is an important factor to consider in study designs in the future. In the randomly assigned groups 57% were satisfied compared to the non-randomly assigned groups where 95% were satisfied. They wrote:

> A randomized controlled trial has many advantages...but is not easily achieved. Despite every effort, only about half of the subjects in the study had their intervention program randomly assigned. Early intervention in Australia claims to be 'family

centered'. One of the implications is that families should have the right to choose the program type for their child. Randomizing subjects into groups was a difficult concept not only for families, but also for many of the staff involved in early intervention programs. Many therapists felt that families should not be asked to participate in a randomized study. This problem was addressed by holding meetings and undertaking protracted discussions with professional groups.

Sixty nine children were originally assessed, but three withdrew. The authors do not discuss the impact of this on the study. They do note that children with severe visual or hearing impairment were excluded.

The selection criteria for the sample was not clearly stated, but can be inferred by the description of the sample. It is unknown what population the sample was drawn from. The sample ranged from ages 12 to 36 months.

Thirty-four children were matched by age, physical diagnosis and cognitive ability, and then randomly assigned to groups. The randomly assigned groups appeared to be fairly well matched, while the non-randomly assigned groups differed in some aspects like severe quadriplegia (n= 7 in the CE group, n = 5 in the control). Other factors such as socio-economic status and educational level of parents were not included in the matching. The authors stated this was not possible.

2. ***The study should provide an adequate description of experimental and control groups.***

   The numbers of children in each group were specified. The age range and average age at baseline were stated for the overall group, and there was a description of the two groups by physical diagnosis, level of motor impairment, and cognitive ability. The authors did not discuss history of treatment of the children in the sample or history of disease and health status.

3. ***The study should provide an adequate description of the context of the study.***

   A brief description of Australian CE-based programs was provided. The programs have been modeled on the 'mother and baby-style' program that are less intensive than the Hungarian ones and staffed by Australian therapists and teachers with Hungarian conductors as consultants. In this study CE was compared to traditional NDT. These were not described.

   The study was funded by a National Health and Medical Research Council Project Grant. Funds were used to establish an additional CE-based group and to equalize hours for some individual therapy. "Traditional" therapy then was not traditional for all programs; rather it was altered for this study and results may be in part due to this.

4. ***The study should provide an adequate description of the interventions/ program.***

   The researchers described the differences and similarities between the two programs. Both the CE and control group programs were described in broad conceptual terms, but no day-to-day activities were noted.

   For the randomly assigned groups the researchers attempted to ensure that treatment hours between the randomly assigned CE and control groups were similar. All children received just under three hours of therapy per week. Initially there were concerns about the program intensity. Children participating in the 'mother and baby' CE groups generally had more program hours than the control group. The implication is that those children who had more hours of program time might have demonstrated enhanced progress. This was overcome by providing additional program time for the control group. Thus, the control group became an artificial group, not representing current therapy in Australia.

   The children in the non-randomized groups received differing amounts of therapy time. The CE group received just over 3 hours per week of therapy, as compared to the control group who received 2.2 hours per week. The reasons for this difference were inevitable (personal communication, D. Reddihough) as the parents continued with their choice of program which was therefore not modified in any way to equalize hours. The researchers did not discuss the implications of this difference on the results.

5. ***The study should provide a description of the statistical methods used.***

   The authors reported means, standard deviations, F-values and probability levels. Results were presented separately for the randomly assigned and non-randomly assigned groups.

6. ***The study should report outcome measures.***

   The VAB was used to evaluate progress of the children, and three therapists, blind to group membership, completed the ratings. The order of the tapes were also randomly assigned so that it was not evident to the raters whether they were assessing the pre- or post-intervention tapes. The researchers also used other instruments including the QRS-F, Reynell Developmental Language Scale, the Parenting Stress Inventory, and the Gross Motor Function Measure (GMFM). The reliability and validity of these were not discussed in this study; however, they have been presented in previous studies. They noted that high inter-rater and test-retest reliability of the VAB measures provided some validation for the use of this type of assessment.

   The authors included the GMFM as an additional test, however it was not administered to all subjects as it was included later in the study.

Raters were asked to determine the group membership of each child. They were right 59% of the time, wrong 22% of the time, and unsure 19% of the time.

The time period (6 months) for this study was short. The authors write; "it was also acknowledged that families want to sample various approaches. If a longer period of study had been chosen, it is possible that there would have been a considerable loss of subjects".

A retrospective parent satisfaction survey was also completed as part of this study, with methods, rating and results reported in terms of percentages. Although the satisfaction survey was intended to be anonymous, some parents indicated their identity. The authors concluded that there seems to be little difference in satisfaction between those involved in the CE-based and control groups.

No follow-up was presented, although the researchers noted that funds were acquired for some resources to provide programs for families after completion of the 6-month program.

Three withdrawals were mentioned but the reasons for this or the effect of the withdrawal on the study were not discussed.

Bochner, Center, Chapparo & Donnelly [8]

This is the fourth (although unrelated) study that was conducted on CE in Australia. It is also the most recent.

Critical Appraisal of the Bochner et al. studies.

1. ***The study should provide a description of the sampling strategy used.***

   The studies were designed to evaluate the School and Preschool Projects. The studies were a pre-post intervention design. The sample was very small in both projects (N=6, N=7). No control groups were included.

   The children in these projects were self-selected by parents who initiated the projects, provided the funding and contracted conductors from Hungary. Bochner et al. [7], in another article, noted that these parents took extreme steps to obtain effective intervention for their children. They saw CE as providing an intervention program with a more intensive therapy component than their children were currently receiving. Bochner et al. [7] stated; "when parents of children with physical disabilities are asked about the type of help needed, therapy is often listed as the most important, particularly by parents of children with severe disabilities". The efforts of the parents and level of commitment to the intensity of the therapy are factors that may have biased the results.

2. ***The study should provide an adequate description of experimental and control groups.***

   The demographics of each of the children in each of the projects were briefly provided. In the School Project the authors stated that all six students "were brain damaged with motor impairments of varying degrees of severity and different levels of intellectual development". The children in the Preschool Project all had CP characterized by differing functional abilities ranging from independence to the need for full assistance in all aspects of daily living. The age and sex of the samples were described for both projects. Although no details were given of previous therapy or health status, the authors noted that some children were already attending a support class for children with physical disabilities.

   No information was provided about the parents in this study, or their experience with treatment and CE. It would have been helpful, considering the extreme effort of the parents, to have included some of this information, as well as information about socio-economic status and educational level.

3. ***The study should provide an adequate description of the context of the study.***

   Both projects were organized by the parents who funded Petõ-trained conductors to come to Australia to work with their children. They then sought support from the NSW Department of School Education who provided classroom space and a teacher and aide.

   Although the projects were like Hungarian CE, they differed in several aspects. The groups were smaller than those at the Petõ Institute and there was greater coordination of academic and therapy programs. The conductors worked with the teacher and an aide in the School Project. The fully integrated nature of academic education and therapy as attained in the Petõ program was not achieved.

   Bochner et al. [7] in their 1996 article that discussed the two programs commented on the teacher's satisfaction with the projects. They noted that data collected highlighted the excitement and satisfaction of the teacher's involvement in the children's program; however, efforts to integrate the education and therapy parts of this program did not appear to be very successful. The academic part was carried out in a separate classroom with the teacher working alone. Moreover, they noted the communication components of the programs were neglected. They wrote:

   > It is difficult to see that there can be a complete transfer of knowledge across discipline areas. The conductor represents an ideal which is unrealistic when viewed in terms of the sophistication of the professions encompassed in this role. The conductor was probably appropriate at the time that Petõ

developed his program, but is not an appropriate model for service delivery in a more sophisticated and technologically advanced system of special education.

These same authors also noted difficulties with transporting the Hungarian conductors into the Australian system. They stated that poor English spoken by the conductors limited the language development of the children. In the Preschool Project the children lacked role models in terms of language development. Other issues included heavy parental involvement in the School Project and a lack of opportunities for contact with peers in integrated settings. Finally, a major problem with the CE was the segregation of the programs from the mainstream schools.

4. ***The study should provide an adequate description of the interventions/ programs.***

In both projects Hungarian conductors were used. The projects were quite intense, averaging 20 hours per child per week. Self-care and motor aspects of the CE program took up most of the day and only limited time was set aside for other aspects of the curriculum (academic). It appears, other than the teacher and occupational therapists (OT), that no other therapists were included in the programs (although academic assessment was done by OTs, special educators and speech pathologists in the School Project). Only the occupational and academic aspects of the program were described.

Parental involvement was not clearly stated, but was discussed previously by the same authors [7], who stated that parents were heavily involved in the School Project as volunteers.

5. ***The study should provide a description of the statistical methods used.***

Percent change was used as a measure for the occupational results, and the parameters for clinical significance were described. The statistical methods for the academic assessment were not described.

6. ***The study should report outcome measures.***

Time periods over which outcomes were measured were stated. The outcome measures consisted of OT assessments on six self-care tasks: eating with spoon or fingers, drinking, dressing, sitting, standing, and three upper limb skills. Task analysis procedures were used in the OT assessments which the authors noted were "sensitive to small changes in children with severe disabilities" [8]. This involved breaking each task into a series of steps and rating each step. A six point scale was used for this. A total percentage of independence was then calculated for a student on each task by comparing the task score with a criterion of 100%. The authors reported that reliability and validity of this method had already been established by themselves in 1992 [6]. Conservatively, the researchers decided that only changes greater

than 10% in level of independence would be accepted as clinically significant, while changes less that 5% would be attributed to random variability.

Academic assessments included assessment of reading and number skills, assessments of communication skills, classroom observations, administration of questionnaires and interviews with parents and staff. No standardization of the assessment instruments was discussed. The procedures to assess academic skills were developed in consultation with the teacher.

Motivation of the children was also assessed for children in the School Project. The level of motivation and cooperation varied. All children were initially highly motivated; however, two of them did not maintain their motivation. Both were capable of more cognitively demanding tasks and a lack of challenge may have contributed to their decrease in motivation. As well, the authors noted that much slower changes in observed motor skills over the second year of the School Project indicated "the students may have responded primarily to the novelty of the new program".

Drop-outs in the School Project and reasons for withdrawal were provided. No drop-outs occurred in the Preschool Project. No follow-up was discussed.

Sigafoos, Elkins & Kerr [38]

This was the fifth study on CE conducted in Australia. The program that was evaluated was organized by parents with the purpose being to focus on parental expectations and observations, rather than those expressed by involved professionals.

Critical evaluation of the Sigafoos et al. study.

1. ***The study should provide a description of the sampling strategy.***

   This study was an uncontrolled case-series. Ten children were voluntarily enrolled based on parental interest. Data was only collected on nine children. No selection criteria was provided as participation was voluntary for those already enrolled in the program.

2. ***The study should provide an adequate description of experimental and control groups.***

   Demographic data on the children were provided; however, no data on parents participating were provided. The type and level of severity of CP were provided. Previous treatments were mentioned, but only those that were related to CE.

3. ***The study should provide an adequate description of the context of the study.***

   Very little information was provided about the context. The study occurred in Brisbane, Australia. The researchers brought in three conductors from the Petõ Institute to implement the program, so one can assume it was based

directly on that model, although this was not clearly stated. No funding information was given, although it inferred that parents paid for the program.

4. ***The study should provide an adequate description of the intervention/ program.***

   Again, little information was provided. The authors noted that three conductors from Hungary implemented the program and that the program was organized by parents. The children received treatment for 3 to 6 hours per day in a separate classroom in a primary school. The mothers of four children in the younger group were present each day. No mention of the level of involvement of other parents was given.

5. ***The study should provide a description of the statistical methods used.***

   This was a descriptive study that presented some ratings for a few children. No statistical tests were used.

6. ***The study should report outcome measures.***

   The majority of the outcome measures came from parent questionnaires. A summary of parental responses was provided for the entry and exit questionnaires. A brief discussion of the results of videotaped behaviours of a few children was also provided. These were rated by an independent observer. Reliability of the ratings were not assessed. The authors noted results were limited and should be interpreted with caution. There was no follow-up. Permission to collect data was not received from one parent; however, no discussion about the rationale for this was provided.

PARENT STUDIES

Three studies on CE that examined parental reactions, perceptions and satisfaction are presented in Table 2 with greater detail provided in Appendix D, Table 5.

Table 2: Parent Studies

Study	Setting	Methods	Authors Conclusions
Hur & Cochrane [24] Controlled, prospective study over 2 years (assumed to be part of the Bairstow et al. [4] study)	UK	N= 36 mothers of 19 children in the CE group and 17 children in the control group in special education responded 3 times over 2 years to a questionnaire.	Mothers of the children receiving CE were significantly more satisfied than mothers of the children in the control group, although their child's behaviour at home and rate of progress were not significantly different. No differences in the level of stress between the two groups of mothers was found.
Lie & Holmes [29] Descriptive study of parental perceptions of a 3 week CE program.	UK	N=13 mothers and 2 fathers completed a questionnaire that examined perceived benefits of CE.	"The heterogeneity of parental views in this study indicate that CE is not considered a 'cure-all' by all parents".
Hill [19] Descriptive, retrospective study of parents whose children attended the Petõ Institute in Hungary. Time period unknown.	Ireland	N= parents of 8 children contacted, 6 returned postal questionnaires, 2 gave verbal responses to same questions.	Parents were positive about the intensity of the process(5), the value of group work(2), access to further treatment(2), consistency and integration of CE(2). Parents saw CE as most helpful in developing independence skills and physical progress, and least helpful in speech and language, and educational spheres. CE was rated on a scale of 1-5 as higher than local therapy for quality, support and understanding condition.

Hur & Cochrane [24]

This was a 2 year controlled, prospective study of 19 mothers of children in the CE group and 17 mothers of children in the control group.

Critical appraisal of the Hur and Cochrane study.

1. ***The study should provide a description of the sampling strategy.***

   The authors provided a brief description of the sampling strategy. Sampling was not random. This study was assumed to be a part of the study conducted by Bairstow et al. [4] however, the authors did not directly refer to this study.

2. ***The study should provide an adequate description of experimental and control groups.***

   The families were described in terms of occupation, family size and composition, and social class by group assignment. No ages were given. Previous experience with treatment programs was not described, nor was there any information given about the children.

3. ***The study should provide an adequate description of the context of the study.***

   The authors provided a good description of CE in Hungary; however, very little information about CE in the Birmingham Institute was presented.

4. ***The study should provide an adequate description of the interventions/ program.***

   No description of the programs were provided. The amount of involvement of the parents in their child's program was also not given. As noted above, this information was provided by Bairstow et al. [4], however, no reference to any other reports about the program for the children was given.

5. ***The study should provide a description of the statistical methods used.***

   A two-way analysis of variance was conducted on the data. The F value and probability level was given for the one significant effect.

6. ***The study should report outcome measures.***

   The outcome measures included a questionnaire administered on three occasions over 2 years, to measure the mother's stress, the Malaise Inventory, and a checklist to measure the child's behaviour problems at home. No discussion about the reliability of the measures or development of the questionnaire or the checklist were provided.

   The results were briefly presented for each group with a discussion of the implications.

   The authors stated that some mothers failed to return the questionnaire on some occasions, therefore the number of responses was not always the same. They present the numbers returned on times 1, 2, and 3, but did not discuss the effects of non-respondents.

Lie & Holmes [29]

This was a descriptive, retrospective study of parents whose 16 children were enrolled in a very short (3 week) CE program in the UK.

Critical appraisal of the Lie and Holmes study.

1. ***The study should provide a description of the sampling strategy.***

   No random assignment and no control group were used. Thirteen mothers and two fathers completed a questionnaire at the end of the program. It is not clear whether the fathers were from different families. The children were enrolled in a three week program by parents if they met assessment criteria of the conductors and parents paid the fees.

   The authors stated that informed consent to participate in the study was received from parents of 15 of the 16 children enrolled in the program. No

further discussion was provided of why the 16th parent did not wish to participate.

2. ***The study should provide an adequate description of experimental and control groups.***

   The mother's ages were given (mean); however, no ages of fathers, or occupational information or educational levels were provided. Previous experience with other therapies was provided. Twelve of the children had attended a similar program previously. In view of the fact that parents had to pay for the current program, one would assume a level of satisfaction had occurred previously with CE and that these parents had seen some benefit for their children. Hence, the sample was likely biased.

   The children ranged in age from 29-92 months (mean=61.8 months). Twelve were male and three were female. Out of the 15 children, 10 were identified as being "at risk" for emotional problems. No other information (including diagnosis) was provided.

3. ***The study should provide an adequate description of the context of the study.***

   The authors provided information about the number of hours of therapy but little other information about the context of the study. The program was run by visiting Hungarian conductors.

4. ***The study should provide an adequate description of the interventions/ program.***

   The children attended the CE program either for a morning or an afternoon session (3.5 hours) for 5 days per week. Three conductors ran the program; however, no other information was given (i.e. equipment used, parental involvement).

5. ***The study should provide a description of the statistical methods used.***

   The researchers used logistic regression analysis to examine the data. Data were reported along with probability levels. Percentages of responses for the questionnaires were also reported.

6. ***The study should report outcome measures.***

   A questionnaire was developed for this study to examine parental views of CE. It was only given to the parents at the end of the study. It was developed from statements derived from both the literature and parental interviews. No mention of reliability or validity testing of the questionnaire. No mention of follow-up to the study was provided.

Hill [19]

This descriptive, retrospective study examined the expectations and experience of eight parents in Northern Ireland whose children had attended the Petõ Institute in Hungary.

Critical analysis of the Hill study.

1. ***The study should provide a description of the sampling strategy.***

   The sample of parents were personally known to the researcher. He did not provide information about how he got to know them. Of the eight families, only six responded to the postal questionnaire. Hill stated that the other two families talked to him; however, it is unknown if they answered the same questions as those asked in the questionnaire.

2. ***The study should provide an adequate description of experimental and control groups.***

   There was no control group. Hill provided some information about the children of the parents, but no information about the parents themselves. He did not provide information about their educational or socio-economic status.

   Information about the children included their age, sex, degree of physical disability, accompanying medical disorders, previous experiences with treatment programs, and current placement in programs. Seven of the eight children had CP and one had a developmental brain abnormality.

   Hill provided some information about previous CE treatment received by the sample. He wrote that "in addition to the initial assessment, five had been for treatment at the Institute on two occasions, and one on one occasion (range 4 to 12 weeks, mean 9.3 weeks)".

3. ***The study should provide an adequate description of the context of the study.***

   The parents had returned to Ireland when they received the questionnaire. Hill stated that in order to have access to CE, the parents incurred considerable expense and some children were separated from their families for prolonged periods.

4. ***The study should provide an adequate description of the interventions/ program.***

   The treatment program was "pure" CE as practiced in Hungary; however, the length of time the children attended for or if they were all there at the same time is not known. Hill stated that because of the way CE is organized in Hungary, five of the six parents were unable to be routinely with their child during treatment time.

5. ***The study should provide a description of the statistical methods used.***

   The author presented mean ratings and total number of responses in some categories.

6. ***The study should report outcome measures.***

   The only tool used in this study to collect data was the questionnaire that was mailed to parents. No information was provided on how the questionnaire was developed. The questionnaire was designed to examine experiences of local resources, CE, and parents' opinions about the future development of services for handicapped children.

SUMMARY OF CRITICAL APPRAISAL OF PRIMARY AND PARENT STUDIES ON CONDUCTIVE EDUCATION

Of the primary studies reviewed only one study randomly assigned the children to either a control or CE intervention group [35]. In two of the studies, children in the CE group were matched with children in the control group on various characteristics including severity of CP and cognitive ability [4, 10]. One study included a control group but without matching [13]. In two studies, no control group was included [8, 38]. The samples were convenience samples of children already enrolled in the programs. All studies were based on small sample sizes.

Of the parent studies only one included a control group [16]. The other two parent studies were descriptive with very small sample sizes.

The criteria described by Lonigan, et al. [30] for empirically supported treatments were used in this review to determine the strength of evidence. The criteria are described in the methodology section (Appendix A).

According to the first set of criteria, for CE to be considered a "well-established psychosocial intervention for childhood disorders" [30] the results of *at least* two well-controlled studies conducted by different investigators would need to show that CE is superior to alternative treatments, or equivalent to an already established treatment. In addition the use of treatment manuals is preferred, and sample characteristics must be clearly specified.

No two primary studies demonstrated that CE is superior to alternative interventions. Each study seemed to be looking at a different model of CE. Results of the four "well controlled" studies utilizing quasi-experimental designs are mixed [4, 10, 13, 35]. Three of the studies were conducted by the same group of investigators [10, 13, 35] and the one that was not did not demonstrate statistical differences between the CE group and the control group who received special education programs [4]. In fact, in their study Bairstow et al. [4] reported that there was evidence of deterioration in hip movements in the children in the CE group that was not evident in the control group. The parent studies do not meet this criteria either, as no two studies were *well-controlled.*

According to the second set of criteria, for CE to be considered "a probably efficacious psychosocial intervention for childhood disorders" [30], the outcomes of two studies showing that CE was more effective than a control group, *or* two group-design studies meeting criteria for well-established treatments (conducted by the same investigator) would be required. The studies should use treatment manuals, and sample characteristics must be clearly specified.

Using this set of criteria, CE cannot be considered "probably efficacious". The three primary studies conducted by the same group of investigators did not

establish that CE was better than the interventions received by the control groups. Coleman et al. [13] found no significant main effects; however, they did report that the children in the CE group showed a consistently larger improvement than the children in the control group based on gross motor, fine motor, receptive language, grooming, and feeding outcomes. Catanese et al. [10] found that the children in the CE group had significantly improved gross motor performance, fine motor performance and activities of daily living; however, the children in the control group showed a greater improvement on cognitive tests. Reddihough et al. [35] stated that children involved in the CE-based programs made similar progress to those involved in traditional programs. Once again, the parent studies do not meet this criteria as only one study used a control group.

DISCUSSION

CE programs have been modified so much, with components from other approaches and special education, that researchers face major problems because of the rapid rate of development in this sector (personal communication, A. Sutton, D. Reddihough). CE can be manifested in different ways in different social contexts. Hence, the published effectiveness evidence for CE is inconsistent, no conclusive statements on the superiority or harmful effects of CE over other traditional therapy for children with CP can be made. In the studies reviewed the children in the CE groups appeared to keep pace with children in control groups. Only one study identified any issue with harm. Bairstow et al. [4] noted that hip mobility was decreased in children undertaking CE. This finding was not reported in other studies.

Catanese et al. [10] expressed some concern about the development of cognitive abilities in children attending CE programs. They stated that:

> "there is evidence to favour the Yooralla group with respect to motor performance and parental coping. The issue with respect to cognitive performance is less clear. It has been suggested that children involved in CE programs may concentrate on motor activities to the detriment of other aspects of development."

None of the remainder of the three controlled studies found that the CE group performed worse than the control group on measures of cognitive ability. In fact, Reddihough et al. [35] noted that the CE group improved significantly more than the control group on the cognitive variable of the VAB.

Overall, the parent ratings of CE are more favorable than outcomes measured for the children. In two studies in Australia, significant differences in favour of CE were found by the parents of children in the CE group over the parents of children in the control groups (in areas of gross motor skills, fine motor skills, activities of daily living [9], social interaction and play [19]).

Methodological Issues

The efficacy of one particular intervention over another with children who have severe motor disorders is difficult to evaluate because there are too many variables in the population which are difficult to control [22]. Some of the methodological difficulties this creates include: identifying a sufficiently large, homogeneous sample to examine specific treatment modalities with adequate power; eliminating potentially confounding effects of associated disabilities, such as mental and sensory deficits; identifying children at a young enough age to eliminate confounding effects of earlier treatments; studying children in a controlled setting; applying treatments in a standard manner, thereby allowing

conclusions to be drawn about the practice; and selecting outcomes that are measurable, and sensitive enough to detect change. No research has been able to address all of these issues. Research on the effectiveness of CE is complicated even more by the factors already noted, such as a lack of theory, description and the adaptation of CE from its original practice in Hungary to other social contexts.

Sampling

Of the studies reviewed, only the study in Australia by Reddihough et al. [35] could be classified as a true experimental design, involving random assignment. This study used a control group that received individual therapy sessions and the children also attended a playgroup with their caregiver. Three of the studies were quasi-experimental designs, all using pre-existing groups, making sample bias a threat to validity [10, 13, 35]. The remaining two studies were observational, increasing the threat of sample bias [8, 38]. In some of the studies the same person(s) were involved in providing treatment and evaluating progress creating a potential source of further bias [8, 38].

Small sample sizes do not have enough power to detect small effect sizes; therefore, there is a greater risk of making a Type II error (possibility of failing to reject the null hypothesis when it is false). In all of the studies reviewed, the sample sizes were small. In the two descriptive studies the sample sizes were extremely small [8, 38]. CE may indeed have been successful in facilitating progress in the children who received it; however, because the sample sizes were so small in these studies, statistically significant results may not have been demonstrated. Adding to this is the further complicating factor that with children who have severe disabilities, the changes that occur would likely be small, and develop over a long period of time. This makes changes with small sample sizes even more difficult to detect.

In addition to the small sample sizes in the studies reviewed, the samples were not homogeneous on such factors as diagnosis. CP covers a wide range of impairments and disabilities. Of the studies reviewed, all but one was very specific stating all children in the sample had CP [8]; however, in this population, a diagnosis of CP does not ensure homogeneity of the sample. This factor makes it very difficult to control for all of the confounding variables that could have affected the outcomes of the research. Three of the studies used matching to help control for some of the confounding variables [4, 10, 35]. None of the studies were able to control for enough variables to state that groups were directly comparable. In the study by Catanese et al. [9], some children in the CE program were of school age since their parents' requested that they be kept in the CE program for an additional year which delayed school start for one year. The control group was matched for age and some of them attended school. Therefore, even though matched, the groups received a range of different

educational services and intensity levels. In the Reddihough et al. [35] study, the groups were matched only on three variables while others were not controlled for. It is very difficult to achieve samples of children with CP who are similar.

Measures of Children's Progress

A range of outcome measures have been used in the reviewed studies assessing CE programs for children with CP. Three of the studies used the VAB [10, 13, 35]. One of the studies (Bairstow et al. [4]) used a battery of 47 tests to measure outcomes. The remaining two studies used unstandardized assessment tools (OT assessments and questionnaires) [8, 38]. There appears to be little commonality of instrument use making comparisons of studies difficult. In addition, the validity of using norm-referenced assessments to measure change over time with this population has been questioned [27]. Sutton [42], in his response to the study measures used by Bairstow et al., wrote:

> The report makes no reference to the serious problem of obtaining meaningful scores from psychometric testing of disabled children. Good clinical and educational practice does not aim for numerical scores, as these can be wildly misleading. Having independent observers mark the tests does not avoid this problem. Without very clear assurance of why this large raft of numerical scores might be regarded as valid for the population tested, one should be forgiven for wondering whether all that this study demonstrates, on children attending four schools across the country, is the general and well-known problem of finding instruments appropriate to documenting the skills and development of children with cerebral palsy.

Rosenbaum et al. [37] described some of the challenges posed in evaluating change in motor function in children with CP. First, they noted, even though CP is considered a non-progressive disorder, changes do occur in the clinical manifestations and behaviours of children with this disorder due to CNS development, motor learning and therapy. Any instrument used to assess the motor function of these children must be selected on the basis of clinical relevance and potential responsiveness to change. The authors wrote that one of the methodological difficulties with studies of children with CP and efficacy of outcomes, is the absence of appropriately validated measures that are responsive to clinically important functional change.

Woolfson [46] noted that one of the problems with studies of efficacy of programs for children with CP is that the measures may not have assessed all the areas in which progress could have occurred. The scope of the instruments used to measure progress influences the reported efficacy of the intervention. Although the three studies in Australia and the one by Bairstow et al. seemed to have used outcome measures that were quite diverse, it is quite likely that various

outcomes were not tapped by the measures. Palmer [33] stated that measured outcomes should be comprehensive and could include domains of pathophysiology, impairment, functional limitations, disability and societal limitations. Few studies have attempted to examine more than one or two of these domains. In reality, this is difficult and may be impossible due in part to a lack of relevant tools.

Another issue to consider when assessing the outcomes of CE programs is clinical versus statistical significance. In four of the studies reviewed, when the researchers reported a significant difference they meant that statistically speaking there was a difference. However, that does not necessarily mean that there is a clinically significant difference. Mathematically, a child's score may be significantly higher post treatment, but the progress made may not be "real" progress. In a study, for example of IQs, a one point increase in IQ could be significant if the sample were large enough, however, this wouldn't mean much in terms of clinical importance. Catanese et al. [10] note that it is difficult to assess the clinical significance of the intervention effects observed in the study. In order to do so, they state that a comprehensive clinical evaluation before and after the intervention would be required. None of the other studies present any discussion of whether or not there was any clinically significant progress in the children.

Service/treatment Programs

It is not possible to draw generalizable conclusions about the interventions in the studies reviewed because few studies adequately described the specific content of the programs. In the absence of a detailed description of the interventions being tested (CE and others) there is no means of determining if the results of a study are due to the specific intervention. None of the studies discussed the use of treatment manuals. This is one of the criteria set forth by the Task Force as being preferred for "identifying a well-established" or "a probably efficacious" psychosocial intervention (Lonigan et al.) [30, 43]. Some of the studies reviewed did not present program features in great detail [8, 10, 38]. Even those studies that described some of the program features [13, 35] did not provide enough details of the intervention programs so that interventions could be replicated exactly.

All of the programs utilized conductors either to deliver services to the children, or to provide advice and direction (three of the Australian studies). The notion that all conductors provide services in the same way is described as a myth by Kiesler [26] as even services by similarly trained individuals will vary. In the Bairstow et al. [3] study, senior conductors were involved in the selection of the children based on pre-set criteria. Hur [23] noted that even their judgement was not reliable and wrote: "It is believed that these obvious errors were due to the unsophisticated and nonstandardized selection methods employed by the conductors".

CONCLUSIONS

The purpose of this review was to examine the empirical evidence of the effectiveness of CE and derive conclusions from existing research literature. Because of the major limitations of all studies to date, evidence on the efficacy and effectiveness of CE is sparse and of poor quality. The efficacy of CE is not established, nor is the nature of CE well defined as it is a fast-developing educational approach.

CE has been surrounded by controversy since its first introduction to other countries. Parents, health and educational professionals are highly motivated to help this group of children with severe difficulties and are drawn to CE. CE is an approach that offers hope. The hope that may have been created by the mass media and anecdotal reports of success for children with CP, is to date not supported by the research literature. Unfortunately available scientific literature does not show this approach to be superior to, or more effective than other treatment methods; nor does it establish which versions of CE should be looked at further. The research evidence, while not establishing that CE is more effective than other forms of therapy for children with CP, does seem to indicate that children in the CE groups kept pace with their peers receiving other therapies. Other than the issue of decreased hip mobility identified in the Bairstow et al. study, which was not reported in any other study, no harm from CE was identified.

There is a need for rigorous studies and program evaluations of CE. True-experimental designs that control for extraneous variables such as the influence of extraneous events, maturation bias, testing and instrumentation bias, statistical regression, selection biases, attrition and diffusion of intervention [22], would require control and experimental groups where subjects are randomly assigned. At the very minimum, careful matching of groups to equate the subjects or hold extraneous variables constant needs to occur.

Most studies on CE provide little information about the characteristics of subjects and rely on small samples. These are important considerations for future evaluations. In addition, the programs and therapeutic interventions need to be described at length, and it is desirable as noted by Lonigan et al. [30] to utilize treatment manuals that provide a detailed description of the interventions. These authors state that "manualized treatment not only allows statements to be made concerning specific interventions but also provides the necessary detailed description and standardization for replication, dissemination, and adequate training of therapists" [30].

It would also be useful in studies on CE to isolate the two main components of CE (the inclusion of pedagogy and conduction) and evaluate their effectiveness.

This could be accomplished through comparing children who receive the isolated component, such as the presence of a conductor, to those who did not.

Outcome measures for the evaluation of CE need to be comprehensive. An outcome model proposed by the National Advisory Board on Medical Rehabilitation Research [1] includes domains of pathophysiology, impairment, functional limitations, disability and societal limitations. Parental outcomes such as parental satisfaction, parental coping and learning merit examination in future research. Clinical outcomes could also be measured and included in any discussion of program effectiveness.

Qualitative methods of research could be used to study outcomes of CE. All of the studies reviewed were quantitative, even those attempting to examine parents' perceptions. It is clear from the work that was reviewed that there is very little understanding of the CE experience for children and perceived value to parents. Quantitative data cannot tell the whole story. Rigorously applied qualitative methodologies would help shed some light on this.

Both quantitative and qualitative methods have complementary strengths that could be used in evaluation research. Information obtained from more than one methodological viewpoint can be advantageous in any research. For example, parents have tended to rate CE higher than what can be substantiated from standardized outcome measures on the children in many studies. Qualitative studies may provide an understanding of the outcomes parents consider important for their children.

Finally, it is important in any research studies on CE to conduct evaluation in the setting CE has been adapted to. CE is practised differently in different countries due to different social contexts. Most adaptations of CE have not involved residential treatment (as originally practiced in Hungary); some use conductors only, while others use multi-disciplinary teams. Outcomes and conclusions from research conducted in other countries, or from other programs may not be transferable to other settings. Local evaluation of CE is imperative. Future research needs to be undertaken which attempts to identify the efficacy and relevance of the approach of programs offering CE in Alberta. To conclude, until necessary steps are taken to rigorously evaluate CE in local settings the empirical legitimacy debate on CE will remain unresolved in Alberta.

APPENDIX A: METHODOLOGY

A literature search was conducted using the approach described below. For each of the citations considered, the abstract was read (where available). From the references identified, a selection was made and full text articles that met the following criteria were retrieved:

- Articles focusing on children with cerebral palsy, learning, intensive therapy, conductive education.
- Review articles on therapy programs/approaches for children with cerebral palsy (referring to critical review and/or meta-analysis) and neurodevelopmental therapy.

Editorials, studies focusing on conductive education with adult populations, and studies older than 1990 were excluded from the review (due to the fact that reviews of the research on conductive education that were found included studies prior to this date).

The search of databases, websites and reference lists resulted in the identification of approximately 210 articles and 14 conference proceedings in total. Approximately 119 articles met the inclusion criteria and were retrieved. Eight conference proceedings also met the inclusion criteria, but only one was available. Through the websites, another ten articles were retrieved. As well, information on the two programs in Alberta (Renfrew and PACE Programs) was provided to the HTA Unit. Neither program included any research activity reports.

Further relevant articles were found by examination of the references listed in the retrieved papers. Reports published prior to 1990 are quoted when appropriate.

Two reviewers assessed potentially eligible published studies to determine which ones should be included using the following criteria:

- The study investigated the effectiveness of CE for children who had motor disorders such as cerebral palsy, or the perceptions of parents whose children had received CE.
- The study be either observational or experimental and there was evidence of systematic collection and analysis of data.

Six primary studies were chosen. Once the studies were selected, two reviewers then completed an independent critical appraisal of the quality of primary studies on the effectiveness of CE. Previously established criteria were used in order to decrease reviewer bias. Disagreements were resolved by discussion.

In addition to the six primary studies reviewed by two reviewers, three studies were also chosen that focused on parental perceptions and satisfaction. These

studies were only reviewed by one individual, however, the same criteria for selection was used.

Search Strategy

A literature search was conducted on the following data bases: MEDLINE (1966-September 2000), EMBASE (1988-July 2000), HealthSTAR (1975-January 2000), CINAHL (1982-July 2000), ERIC (1985-June 2000), Psychinfo (1984- July 2000), CBCA Fulltext Education (1976-July 2000), and Webspirs Current Contents (1997-Week 44, 2000).

The words 'conductive education', 'conductive learning', 'intensive therapeutic intervention', 'behavioral intervention', 'learning strategy', 'education', 'strategy', 'therapy', 'therapeutic intervention', 'special education', **early intervention', 'functional training', 'teaching methods', 'client education', rehabilitation', 'educational methods', 'cerebral palsy', 'motor dysfunction', and 'motor neuron disease'** were used as subject headings.

These words were used independently and in various combinations. Some of the words were used in multiple databases and others were specific to one database. Those words that are bolded are subject headings specific to one or more databases.

To determine the level of research methods used these subject headings were tried: **Clinical trials, randomized controlled trials, experimental methods, and empirical methods.** There were few articles that were included under these method subject headings when combined with other aspects of the search. Therefore, this limitation was removed, and the study method was determined upon review of the articles.

Websites searched included the National Institute of Conductive Education (NICE) in Birmingham, Inter-American Conductive Education Association, Families of Alberta for CE (FACE), the Cerebral Palsy website, Petõ Institute of Conductive Education, the Conductive Association of Ontario Website, and the National Association for Conductive Education (NACE) website. These searches resulted in no additional primary studies; however, articles were retrieved if they met inclusion criteria.

Critical Appraisal Criteria

All of the primary studies on CE were critically analyzed independently by each of the two reviewers using the following criteria described below. The parent studies were only analyzed by one reviewer. This criteria was derived from a variety of sources including the Evidence Based Medicine Tool Kit [44], Jadad's framework for evaluating randomized controlled trials [25], and criteria described by Lonigan et al. [30]:

1. The study should provide a description of the sampling strategy including:

- Selection criteria.
- Sample selection strategies (who was involved in the selection).
- Size of the sample.
- If any randomization or matching occurred.
- Participants who refused to participate and rationale.

2. **The study should provide an adequate description of experimental and control groups, including:**
   - Demographics (number, age, sex,).
   - Type and severity of CP/other motor disorders.
   - History of disease and previous treatments.
   - Health status.
3. **The study should provide an adequate description of the context of the study, including:**
   - Setting.
   - Country.
   - Any description of funding sources (private/public).
4. **The study should provide an adequate description of the interventions/ program including;**
   - Use of conductors.
   - Inclusion of other therapies (e.g. physio/occupational therapies) and/or professionals.
   - Treatment intensity for both experimental and control groups (frequency and duration).
   - Involvement of parents.
5. **The study should provide a description of the statistical methods used.**
   - Methodological appropriateness of statistical tests used in each of the studies was not analyzed.
6. **The study should report outcome measures including:**
   - Tools and indicators.
   - Whether assessors were blinded to group membership.
   - The instruments along with reliability/validity information.
   - Time periods over which outcomes were measured.
   - Length of follow-up, who did the follow-up.
   - Drop-outs or loss to follow-up and effect on study.

Hierarchy of Evidence

The classification scheme developed by Lonigan, et al. (adapted from Chambless et al. [11]) and Task Force on Promotion and Dissemination of Psychological Procedure [43] for empirically supported treatments) was used in this review to determine the strength of evidence of the studies. Two sets of criteria are described by the authors.

The first set is "*Criteria for Well-Established Psychosocial Interventions for Childhood Disorders*" [30]. For CE to be considered well-established and efficacious these criteria require:

- "At least two well-conducted group-design studies, conducted by different investigatory teams, showing the treatment to be either superior to...alternative treatment, OR equivalent to an already established treatment in studies with adequate statistical power.
- A large series of single-case design studies (i.e., n>9) that both use good experimental design AND compare the intervention to another treatment; AND,
- treatment manuals used for the intervention preferred; AND,
- sample characterisitics must be clearly specified".

The second set is "*Criteria for Probably Efficacious Psychosocial Interventions for Childhood Disorders*" [30]. For CE to be considered "probably efficacious" the following criteria must be met:

- "two studies showing the intervention more effective than a no-treatment control group,... OR
- two group-design studies meeting criteria for well-established treatments –but conducted by the same investigator, OR
- a small series of single case design experiments (i.e., n>3) that otherwise meet Criterion 2 for well-established treatments; AND,
- treatment manuals used for the intervention preferred; AND
- sample characteristics must be clearly specified."

APPENDIX B: CEREBRAL PALSY

Symptoms of CP palsy vary in severity from fairly mild to more profound handicaps. Some children with CP palsy have difficulty with fine motor tasks (writing, cutting), some have problems maintaining balance and walking, and some have problems with involuntary movements and may experience uncontrollable writhing of the hands or drooling.

Other medical disorders are also associated with CP. Many children do not have accompanying medical disorders; however, any disorder that involves the brain and impairs motor function can also cause seizures and impair cognitive function, attention, activity and behaviour, vision and hearing. About one third of children with CP are of normal intelligence, one third are mildly intellectually impaired, and the remaining one third moderately or severely impaired [32]. Those who have spastic quadriplegia are more likely to be intellectually impaired. Seizures or epilepsy affects as many as half the children with CP.

Growth problems are common in children with moderate to severe CP (especially in those with spastic quadriplegia). Manifestations of growth problems include too little weight gain, abnormal shortness, or a lack of sexual development. Muscles and limbs affected by CP palsy tend to be smaller than normal.

Impaired vision and hearing affects a large number of children with CP. Strabismus, a misalignment of the eyes, is common. Hemianopia, defective vision or blindness that impairs the normal field of vision in one eye can also occur in these children. Impaired hearing is frequently found in children with CP. They may also have an impaired ability to feel simple sensations like touch or pain, or stereognosia (difficulty perceiving and identifying objects from touch).

Physical and Psycho-Social Interventions

CP cannot be cured; however treatment can improve the child's capacities to function. There is no standard therapy for every child. Some approaches that can be utilized for these children include medications to control seizures and muscle spasms, braces to assist in balance, surgery, mechanical aids, counseling, physical, occupational, speech and behavioural therapy.

Types of Therapy/interventions for Children with Cerebral Palsy

Physical and psycho-social interventions for children with CP palsy include physiotherapy, occupational therapy, speech-language therapy as well as psychological therapy. Therapeutic programs that have developed for these children include NDT, early intervention, patterning (also known as the Doman-Delacato method), dynamic systems theory, CE, Vojta therapy, and family-

centred functional therapy. The most common type of therapy in Canada is NDT [28]. Law et al. [28] reported that in a survey of three Canadian provinces conducted in 1994, 64% of physiotherapists and 72% of occupational therapists used the NDT approach and techniques. CE as a therapy option has recently become available in some cities in Canada.

Neurodevelopmental Therapy

NDT is a physiotherapy method. It is one of the most common approaches for children with CP [14]. It was developed by Karel and Berta Bobath in the 1940's. The basic tenets are to "inhibit abnormal tone and primitive reflexes and to facilitate normal movement" [4] primarily through positioning and handling techniques that allow children to experience the sensation of normal movement. The emphasis in NDT is on functional goals; for example, the transition from sitting to standing. NDT aims to facilitate normal motor development and function, and prevent secondary deformities and/or disabilities. Some of the treatment principles include a focus on weight bearing, weight shifting, and normalizing muscle tone. This is accomplished through the use of balls, bolsters, horseback riding, and swimming.

Research on the effectiveness of NDT is mixed. Palmer [33] wrote: "well-designed clinical trials to date have not supported the notion that NDT treatment is effective in positively altering motor development in children with cerebral palsy. However, a blanket statement labeling NDT ineffective is not possible due to the scope, weaknesses and limitations of existing research". Similarly, Fetters [14] notes that the effectiveness of physical therapy (NDT) is not well-documented. He reported that in one meta-analysis of nine studies the conclusion was that overall effects of NDT were positive, although small. Law et al. [28] stated that "studies employing randomized clinical trials have generally produced mixed results that do not support the efficacy of the NDT approach in reducing disability and handicap".

APPENDIX C: CONDUCTIVE EDUCATION MODELS IN ALBERTA

Table 3: Alberta models of CE

Program	Description of Program	Staff	Settings	Comments
Alberta Renfrew Educational Services Funding is provided by Program Unit Funding (PUF) grants, Children's Services funding and parents. *Information from Janice McThighe, June 2000	This program provides 2 hours 5 times per week for infants, 4 hours 5 times per week for pre-school children and 2 hours 2 times per week for school-age children. CE at Renfrew combines education and treatment, motor learning and language development within the context of everyday life. Small group settings are used to increase motivation, gain confidence and experience success.	An adapted Australia model is used with a conductor assisted by Child Development Facilitators. Additional staff include physiotherapists, occupational therapists, speech and language therapists, and family support and child psychology services. Parental involvement is expected.	Programing occurs at the Renfrew site. Renfrew is non-residential. Education takes place for school aged children in the provincial school system.	• Has approved operator status under Alberta Learning and therefore can apply for PUF funding for eligible children. • Extra funding was sought by parents to support the cost of the program.

Table 3: Alberta models of CE (cont'd)

Program	Description of Program	Staff	Settings	Comments
Alberta Principles from the Approach of Conductive Education (PACE) Rehabilitation Program Funding is provided by Handicapped Children's Services and PUF grants. Began as a pilot project in 1995-1996. *Information from PACE Program Binder provided by Helen Enns, May 2000.	This program requires parent participation in all aspects of interventions and provides 2.5 hours per week for infants, 2.5 hours twice a week for pre-school children and 2 hours twice a week for school-age children. The program at PACE includes principles of CE plus "other" educational and therapeutic interventions.	No conductors are on staff. Established on the Australian "transdisciplinary team" model due to the belief that this is safer and more likely to receive funding in Western Society. This program is facilitated by a physiotherapist. Additional staff include physiotherapists, occupational therapists, speech and language therapists, and music therapists. Each child has a team of therapists involved. Parents are actively involved in the group program as well. A teacher is also on staff. Received some training from Hungarian trained conductors on CE and receive ongoing support from therapists in Australia who use the same model.	Treatment takes place primarily at the center, however therapists and the teacher will visit the child and family at home as needed. Education takes place for school aged children in the provincial school system.	• Has approved operator status under Alberta Learning and therefore can apply for PUF funding for eligible children. . • Staff at this site are disturbed that they do not receive a portion of the additional funding granted to the Renfrew Centre. They state their current funding is not sufficient. • The pilot project was originally funded by Calgary Foundations and the Calgary Cerebral Palsy Association and was successful and therefore in June 1996 the P.A.C.E. Rehabilitation Society for children with Motor Disabilities was formed.

APPENDIX D: PRIMARY AND PARENT STUDIES

Table 4: Studies evaluating conductive education

Study	Sample	Method	Outcomes	Comments
Bairstow et al. [4] 1993 Non-randomized, prospective controlled study followed from 1989-1992, UK	N=19 CE group N=17 control group (receiving special education programs). Children ranged from ages 3.5 to 4.5 years.	Two conductors from Hungary chose the CE and control groups. Assessment of 47 variables of independence and functional development occurred at the start of the study, and then repeated at 1 and 2 year marks.	Both groups improved on measures. No statistical differences between groups were found, except that the CE group showed some deterioration in hip movements, not shown in the control group. Parents ratings indicate that both groups improved.	-no randomization, matching occurred -both groups were selected by conductors who were blinded to reduce bias -effect of withdrawals not discussed -substantial differences existed in the programing for the 2 groups
Coleman et al. [13] 1995 Non-randomized, controlled prospective study, 26 weeks in 1990, Australia	N=11 children in the CE group N= 9 children in the control group (receiving early intervention services). Children aged 19 to 69 months	The CE Program included groups "based on CE". The CE group were enrolled in five programs received therapy 5 days per week either in the morning or afternoon. The control group were involved in four centres using early intervention programs.	No main effects or interactions were significant for any of the five areas assessed in both groups. Significant (p=0.001) improvements were seen by the parents for both groups in 4 areas – receptive language, expressive language, social interaction and play.	-no randomization -no matching of groups -small sample size -programs not well described -raters blind to group membership -careful statistical analysis

Table 4: Studies evaluating conductive education (cont'd)

Study	Sample	Method	Outcomes	Comments
Catanese et al. [10] 1995 Non-randomized, controlled prospective study, 26 weeks in 1992, Australia	N= 17 children in the CE group, matched (in terms of severity of CP and cognitive ability) N= 17 children in the control group (receiving individual physiotherapy). Children aged between 4 years to 7 years, 1 month	The CE Program included groups "based on CE"	CE group –improved significantly relative to the control group in the areas of gross motor skills, fine motor behavior and activities of daily living. Children in both groups demonstrated significant improvement on all cognitive tests although the control group showed a greater improvement on cognitive tests than the CE group (significant results for the Columbia Mental Maturity Scale and the Drawing Measure of the WPPSI). For social interaction and play, parents rated control children to have improved more over time than did CE children. For toileting, CE children were rated by parents as having improved more. Parent stress scores only differed on one factor – parent and family problems. A significant difference was found in the CE group showing a more positive response than the control group on this factor.	-small sample size -no random assignment -matching occurred -CE group were previously enrolled in CE program -intensity of treatment for control group not described -statistical analysis -raters blind to group membership

Table 4: Studies evaluating conductive education (cont'd)

Study	Sample	Method	Outcomes	Comments
Reddihough et al. [35] 1998 Randomized, controlled, prospective study, conducted over 6 months. Australia	N= 30 matched pairs that were randomly assigned (N= 15 CE group N= 15 control group receiving NDT) In addition, the study also included 32 children whose parents would not accept random assignment. This group was included (N=15 in the CE group and N=17 in the control group) but the outcomes were treated separately. The children ranged in age from 12 to 36 months.	The CE Program included groups "based on CE" – modeled on the "mother and baby-style" program received guidance from a Hungarian Conductor. Measures used at the beginning and conclusion of a 6 month period, included the VAB, GMFM (this test was not given to all children and analysis included the entire sample, rather than for matched pairs), RDLS, QRS-F and the PSI. Analysis of all data was conducted for randomly assigned groups (CE and control) and for non-randomly assigned groups (CE and control).	Randomly Assigned Groups – the CE group revealed a statistically significant effect for treatment on the cognitive variable of the VAB relative to the control group. Both groups improved statistically in expressive language. The control group showed a statistically significant improvement on the organizational-behaviour variable. Parents reported improvement on many variables for both groups. The parents of the CE group reported greater improvement in dressing than the parents in the control group ($p<0.05$). No differences between groups was found on the RDLS, the PSI, or the QRS-F. Non-randomly Assigned Groups- The control group demonstrated a statistically significant improvement on the cognitive variable of the VAB relative to the CE group. An increase in score in the play variable was seen in the CE group, but not the control group ($p<0.01$). On the GMFM the control group improved more in laying & rolling, standing and total score ($p<0.05$). Parents of the CE group reported greater improvement in expressive language than parents of the control group ($p<0.05$). On the PSI parents of the CE group made greater improvements in perceived coping than the control group ($p<0.05$). No differences between groups was found on the RDLS or the QRS-F.	- despite every effort, only about half of the subjects in the study had their intervention program randomly assigned. - matching occurred for randomly assigned and nonrandomly assigned groups on three variables. - program intensity was the same for randomly assigned groups, not the nonrandom groups - study period was short. - the NDT treatment programs were not described well statistical analysis - raters were blind to group membership.

Table 4: Studies evaluating conductive education (cont'd)

Study	Sample	Method	Outcomes	Comments
Bochner & Chapparo [8] 1999 Evaluation studies of 2 CE programs, The School Project, and the Preschool Project. Non controlled, descriptive, the School Project occurred over 2 years, the Preschool Project operated over a 12 month period, Australia.	School Project N=6, 4 boys, 2 girls between the ages of 6-12 years. Preschool Project N=7, 5 boys, 2 girls, between the ages of 3 and 6 years.	In the school project two conductors were assisted by a teacher and an aide. In the preschool project the conductor was unassisted. Occupational therapy (OT) assessments were completed for both projects. For the school project this focused on 6 self care tasks which were rated on a 6 point scale by an experienced therapist. For the preschool program the OT assessment focused on self care, mobility and upper limb skills. Data were collected for the academic aspect of the study and included academic assessments in number and reading skills, communication skills (school program), expressive and receptive language skills (preschool program). Parents were involved as volunteers in the study.	Changes greater than 10% in level of independence were accepted as clinically significant. The School Project: OT assessments - the most improvement was in the standing program. Academic assessments- no or little change over the period of the study. The Preschool Program: Most improvement was in potty training and plinth exercises such as rolling, upper and lower limb movements. Six out of 7 showed improvement. Two of the children showed improvements greater than 10% in 8 out of 12 skills assessed, however 2 children showed little change in any of the assessed areas. Academic skills -the children made only minor changes.	- no random assignment or control groups - parents arranged the CE program and funded it -small sample in each project - programs quite intense (20 hours per week) - no statistical analysis - outcome measures limited to OT and academic assessments - assessment tools not well discussed

Table 4: Studies evaluating conductive education (cont'd)

Study	Sample	Method	Outcomes	Comments
Sigafoos et al. [38] 1993 Non-controlled, descriptive study over 6 weeks, Australia.	N= 10 children who enrolled voluntarily in a 6 week CE program. The children ranged in age from 22 months to 127 months. Data were collected on 9 out of the 10 children. The program was organized by parents.	All of the children were removed from school to participate in the program. Three conductors from Hungary implemented the program. The parents of 9 of the 10 children completed an entry and exit questionnaire Videotapes were made to provide an objective source of data. Only the older group of children were videotaped due to time and resource constraints.	The parent's questionnaire seemed to indicate that they viewed CE as a fairly comprehensive program. The parents perceived improvement in their child in at least 1 identified goal. Strengths of the program identified by parents included the expertise of the conductors and the intensity of the program, however while this was viewed as a strength, some parents felt that less intensity was called for. Some parents also indicated the desire to have been more involved in the program, although not much information was provided about their level of involvement beyond receiving some training. The videotaped observations indicated that there was little improvement in mobility or eating skills for children in the older group.	- no random assignment or control groups - convenience sample - no statistical analysis - reliability of parent ratings not assessed - very small sample - short study period - observations per child limited to only 2 and for only ½ of the sample - the tapes were rated by an independent observer.

VAB - Vulpe Assessment Battery
RDLS – Reynell Developmental Language Scale
WPPSI – Wechsler Pre-School Scale of Intelligence – Revised
Columbia MMS – Columbia Mental Maturity Scale
PSI – Parenting Stress Index
GMFM – Gross Motor Function Measure
QRS-F – the questionnaire on resources and stress
PPVT – Peabody Picture Vocabulary Test
GMFM – Gross Motor Function Measure

Table 5: Parent perspectives on conductive education

Study	Sample	Method	Outcome	Comments
Hur and Cochrane [21] 1995 Assumed to be linked to the Bairstow et al. study (3). Controlled, prospective study Over 2 years 1998-1991, UK	N=36 mothers of children with CP who were enrolled in a CE program (N=19) or in special schools (N=17). Information about the children was not reported in this study. Information about the parent's ethnic group, size of family, and social class was provided.	A questionnaire was administered on three occasions over two years. It was assembled to measure stress, the child's problems at home, the mother's level of satisfaction with services and the child's progress. The Malaise Inventory was also used to assess the level of stress experienced by parents. Finally, the child's behaviour problems at home were measured by a check-list.	The only significant main variable was that mothers whose children received CE were more satisfied than the comparison group mothers. The authors concluded that greater satisfaction with the program by the mothers of the CE group was a result of their initial faith in this form of intervention, because maternal stress, and progress as well as behavior problems at home did not differ between the two groups. Some mothers (number not provided) were worried about the perceived lack of an academic program for their child, and other useful school-based experience. No significant difference in the number of stress symptoms was found between the CE and control groups. The children's rate of progress for both groups was rated similarly. Initially all the CE mothers appeared to be happy and believed that they had done everything possible for their child. As time passed, some mothers started questioning themselves as to whether they had done the right thing for their child and two openly expressed doubtful feelings.	*No random selection or assignment. *Small sample size. *Self-report biases *No discussion of reliability of instruments, minimal on validity of the Malaise Inventory.

Table 5: Parent perspectives on conductive education (cont'd)

Study	Sample	Method	Outcome	Comments
Lie and Holmes [29] 1996 Descriptive study of parental perceptions of a 3 week CE program, UK	N=13 mothers and 2 fathers of 16 children participated, consent for the study received from parents of 15 of the children. The children ranged from 27 months to 92 months.	At the end of the 3 week program, the parents completed a questionnaire designed to examine the perceived benefits of CE. 22 statements were derived from the literature and from interviews in the preparatory phase to examine: benefits to the child's functional and social development, and the pedagogy used in the program. All parents also rated their child's progress in 11 areas of development: sitting in a chair, sitting alone, rolling, walking, grasping, reaching, speech, toilet, motivation, feeding, and sleeping. Eight of the areas were also rated by the conductors independently of the parents. Conductor ratings were obtained for 10 of the 15 children. The areas of sitting alone at home, feeding and sleeping were not rated by conductors.	The majority of parents perceived benefits to functional development (82%), pedagogy (75%), and language development (61%), although more parents were unsure (36%) about the benefits to language development than the other two areas. The "majority" of parents reported progress in walking, motivation and grasp. Progress was least frequently reported in sleeping, speech, toileting and feeding. The authors reported that the responses indicate that CE is not considered a "cure-all" by all parents. Conductor ratings were not provided, except to note that 8 out of 10 parents rated their child's progress as higher than conductors.	*The results have to be viewed cautiously due to the short nature of intervention. *Small sample size *No control group *Reliability and validity of questionnaire not discussed *Minimal description of the program or children provided
Hill [19] 1990 Descriptive, retrospective study of parents whose children attended the Petõ Instititute in Hungary, time period unknown, Ireland	N=parents of 8 children; 6 responded	The parents of 8 children (ages 3 to 7 years) were sent a postal questionnaire but only 6 questionnaires were returned. Hill stated that the other families talked to him, but did not return the questionnaire. The questionnaire was "designed to look at parental experience of CE", but was not described further.	Parental responses to CE included positive thoughts on the intensity of the process, the value of group work, access to further treatment, consistency and integration of approach. Negative aspects included the separation of the child from the family. Parents saw CE as most helpful in developing "independence skills and physical progress, and least helpful in speech and language and educational spheres". CE was rated on a scale of 1-5 as higher than local therapy for quality, support, understanding condition, but it was rated the same by parents for accessibility.	*Very small sample personally known to the researcher *Descriptive study only *No description of the parents, limited description of the children or services received. *No control group *Not all questionnaires returned although the author noted that parents who did not return it, spoke to him in person.

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